

LERNER AND GREENBERG, P.A.

PATENT ATTORNEYS AND ATTORNEYS AT LAW

2445 Hollywood Boulevard

Hollywood, Florida 33020

Tel: (954) 925-1100

Fax: (954) 925-1101

PATENTUSA®

www.patentusa.com

patents@patentusa.com

Mailing Address:

Post Office Box 2480

Hollywood, FL 33022-2480

Laurence A. Greenberg (FL Bar)

Werner H. Sterner (FL Bar)

Ralph E. Locher (FL, IL, MO Bars)

Gregory L. Mayback (FL Bar)

Manfred Beck (US & German Pat. Agent)

Mark P. Weichselbaum (TN Bar)

Markus Nolff (FL Bar)

Loren Donald Pearson (FL Bar)

Otto S. Kauder (Reg. Pat. Agent)

Denise A. Lettau (DC Bar)

Yonghong Chen (Chinese Pat. Agent)

F. Donald Paris (NY, NJ, DC Bars)

Alfred K. Dassler (Reg. Pat. Agent)

Kyle H. Flindt (UT Bar)

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New York Satellite Office

153 E 57th St., Suite 15G

New York, NY 10022

Of Counsel:

Herbert L. Lerner (NY Bar)

FACSIMILE TRANSMITTAL SHEETTO: **Duy Vu Nguyen Deo**FROM: **Loren Donald Pearson**ART UNIT:
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February 11, 2002☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE**Certificate of Transmission**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Confirmation No. : 5088
Appl. No. : 10/073,550
Applicant : Gabriela Brase, Gregoire Grandremy
Filed : February 11, 2002
Art Unit : 1765
Examiner : Duy Vu Nguyen Deo
Title : Etching Process for a Two-Layer
Metallization
Docket No. : Z&P-INFN10176
Customer No. : 24131

R E S P O N S E:

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Examiner:

The following remarks respond to the Office action dated
September 4, 2003.

Reconsideration of the application is requested. Claims 1-14
remain in the application.

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Reply to Office action of September 4, 2003

In item 2 of the Office action, the Examiner rejected claims

1, 5, and 7 as being fully anticipated by Havemann et al.

(U.S. 6,358,849) under 35 U.S.C. § 102(e). As will be

explained below, the claims were patentable over the cited art

in their original form and the claims have, therefore, not

been amended to overcome the references.

Before discussing the prior art in detail, a brief review of

the invention as claimed is provided. Claim 1 calls for,

inter alia, a method that includes the following steps:

providing a semiconductor structure with functional elements formed in a substrate, a dielectric disposed on the substrate, a photoresist etching mask above the dielectric, and a polymer intermediate layer between the etching mask and the dielectric layer;

etching the dielectric layer and the polymer intermediate layer for the dual damascene patterning with a CF₄ ARC open process with high selectivity with respect to the photoresist of the etching mask. (Emphasis added by Applicants.)

Claims 1 and 9 of the instant application are directed to methods for structuring an oxide layer on a substrate during a double damascene patterning process. Such patterning during double damascene processes is usually carried out using a photoresist in combination with an ARC layer. These two layers are used to structure an oxide layer positioned underneath the ARC and photoresist layer. The use of an

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polymer ARC layer in such double damascene processes leads to the problem of deposition of ARC polymer in the contact holes that have previously been opened. See specification, page 5, lines 12 to 22. This deposition leads to the formation of so-called "fences" around the contact holes. In turn, fences make the subsequent metallization step more difficult or lead to internal stresses in the semiconductor element, proceeding from said fences. See specification, page 6, lines 1 to 5.

The prior art has suggested to reduce the formation of fences by reducing sidewall deposition of polymer during the etching of the interconnect by increasing the addition of oxygen to the etchant. However, this diminishes selectivity towards the photoresist and reduces resolution of the etchant process, i.e. the critical dimension is widened. See specification, page 6, lines 7 to 16.

The present invention solves these problems connected to the use of polymer intermediate layers (ARC-layers) by using a highly selective CF_4 -ARC open process for etching both the polymer intermediate layer and the oxide layer positioned underneath said ARC-layer. This process etches any polymer present in the interconnect at the same time as the oxide so that no fence formation can take place. See specification, page 9, lines 8 to 17.

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In contrast, Havemann et al. (US 6,358,849) describes a dual damascene process using a siliconoxynitride-ARC (SiON-ARC).

See column 3, line 17 to 18 and lines 66 to 67. This is not a polymer ARC, but an inorganic ARC. The problem of polymer deposition during the oxide etch and fence formation caused by this organic polymer deposition is not encountered with such an inorganic ARC.

Consequently, the methods according to independent claims 1 and 9 of the present invention are novel over the art disclosed by Havemann et al. Furthermore, the methods according to the present invention would not be obvious to one with ordinary skill in the art viewing Havemann et al. Not only do Havemann et al. fail to disclose the use of a polymer intermediate layer used as an ARC during the etching of the respective oxide layer, Havemann et al. also use a completely different approach for avoiding problems connected with the presence of interconnects which have already been opened. As becomes apparent from Figures 1h to 1j, in the dual damascene method described by Havemann et al., an interconnect is etched through layers 170, 171 172 and 173; see column 3, line 61 to column 4, line 12. This interconnect is then filled with a temporary filler made of parylene (see column 4, line 8 to 12). This filler remains in the interconnect during the subsequent formation of trenches 180 and is only then reopened

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with an oxygen plasma (see column 4, lines 27 to 31) before metallization.

Therefore, the method described by Havemann is completely different from the method of the present invention.

Therefore, one with ordinary skill in the art would be given no incentive by this reference to use a polymer intermediate ARC layer instead of an inorganic siliconoxynitride ARC layer.

In item 4 of the Office action, the Examiner rejected claims 3, 4, 6, 8, and 9-13 as being unpatentable over Khajehnouri et al. (U.S. 6,117,786) under 35 U.S.C. § 103(a). Khajehnouri et al. only describes an etching process for etching an oxide layer during which polymer deposition is controlled in such a manner that anisotropically etched openings are obtained and etch stop is avoided. Dual damascene processes or the use of polymer intermediate layers (ARC) during oxide etch are not mentioned in this reference. Consequently, the method of the present invention is not made obvious by Havemann et al. in view of Khajehnouri et al.

In view of the foregoing, reconsideration and allowance of claims 1-14 are solicited. In the event the Examiner should still find any of the claims to be unpatentable, please telephone counsel so that patentable language can be substituted.

10-31-'03 16:35 FROM-Lerner & Greenberg +9549251101

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If an extension of time for this paper is required, petition
for extension is herewith made.

Please charge any other fees that might be due with respect to
Sections 1.16 and 1.17 to the Deposit Account of Lerner and
Greenberg, P.A., No. 12-1099.

Respectfully submitted,



LOREN DONALD PEARSON

Reg. No. 42,987

LERNER & GREENBERG, P.A.

P.O. Box 2480

Hollywood, FL 33022-2480

Tel: (954) 925-1100

Fax: (954) 925-1101